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(54) IMPROVEMENTS IN OR RELATING TO POSITIVE DISPLACEMENT FLUID MOTORS

(71) I, LEO LINDSAY TOMPKINS, a citizen of the United States of America, of 127 Wacaster Street, Jackson, State of Mississippi, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to positive-displacement fluid motors.

According to the invention a positive-displacement fluid motor has an inlet and outlet and relatively positionable and movable components coacting to define a working chamber and in which the volume of fluid displaced for each output cycle is varied in response to changes in relative position of said components, the motor comprising means for varying the relative positions of the components for varying the volume of the displacement for each output cycle in response to load characteristics during operation of the motor, said means for vary the position of the components including means for spring biasing said relatively positionable components into a relative position to attain minimum volume displacement for each output cycle, fluid pressure means responsive to an increase in supply pressure at the inlet to shift said components against said biasing means in a direction to increase volume displacement of the motor for each output cycle as the supply pressure increases, and governor means operatively associated with said fluid pressure responsive means to decrease the effect of an increase in the supply pressure at the inlet as the speed of the output cycle increases

The invention may be performed in various ways and two specific embodiments will now be described by way of example with reference to the accompanying drawings in which:—

Fig. 1 is a schematic longitudinal sectional view of a first form of fluid motor constructed in accordance with the present invention and with portions of the fluid control system thereof also illustrated in section;

Fig. 2 is a sectional view similar to Fig. 1 but with the cylinder of the fluid motor illustrated in an eccentric position relative to the rotor axis as opposed to the concentric position of the cylinder illustrated in Figure 1;

Fig. 3 is a sectional view similar to Fig. 1 but of a modified form of fluid motor constructed in accordance with the present invention;

Fig. 4 is a sectional view taken substantially upon the plane indicated by the section line 4—4 of Fig. 3;

Fig. 5 is a sectional view taken substantially upon the plane indicated by the section line 5—5 of Fig. 4; and

Fig. 6 is a fragmentary sectional view taken substantially upon the plane indicated by the section line 6—6 of Fig. 5.

Referring now more specifically to the drawings, the numeral 10 generally designates a positive displacement fluid motor. The motor 10 includes a housing referred to in general by the reference numeral 12 consisting of interconnected top and bottom walls 14 and 16 and opposite side walls 18 and 20. The opposite ends of the housing 12 are closed by means of end walls (not shown) secured thereover and a cylinder body 22 is disposed within the housing 12 and slidable therein toward and away from theside walls 18 and 20. The side walls 18 and 20 include abutment blocks 24 and 26 carried on their inner surfaces with which the opposite sides of the cylinder body 22 are engageable and a pair of compression springs 30 are disposed between the inner surface of the side wall 18 and the opposing side 32 of the cylinder body 22 yieldingly urged the cylinder block 22 toward the limit position thereof defined by the abutment block 26.

The cylinder body 22 includes a vertically extending slot 34 and a horizontal longitudinal center bore 36. A fluid pressure inlet pipe 38 opens into the upper end of the slot 34 through the top wall 14 and a fluid pressure outlet pipe 40 opens outwardly from the lower end of the slot 34 through the bottom wall 16. It is to be noted that the pipes 38 and 40 comprise portions of a closed hydraulic system wherein the pipe 38

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extends from a fluid pressure source (not shown) and the pipe 40 extends to a reservoir or sump (not shown) for the fluid pressure source.

A rotor shaft 42 is journaled lengthwise through the housing 12 and carries a rotor body 44 thereon within the bore 36. The rotor body 44 includes circumferentially spaced spring-urged sliding radial vanes 46.

A fluid pressure bypass line 48 extends from the inlet pipe 38 to the inlet end of a valve cylinder 50 having a piston 52 reciprocal therein. The piston 52 includes a diametrically reduced center portion 54 intermediate two opposite end piston heads 56 and 58 and the head 58 is provided with a fluid sealing ring 60. A pressure conduit 62 has one end communicated with the interior of the end of the valve cylinder 50 into which the line 48 opens as at 64 and the other end of the pressure conduit 62 opens into a pressure chamber 66 disposed between the cylinder body 22 and the inner surface of the side wall 20 of the housing 12. Also, a return line 68 has one end communicated with the interior of the pressure conduit 62 intermediate its opposite ends and the other end communicated with the central portion of the valve cylinder 50. Finally, a bleed line 70 has one end communicated with the outlet pipe 40 and the other end communicated with the interior of the valve cylinder 50 below the line 68.

A governor assembly referred to in general by the reference numeral 72 is provided and includes a rotary head 74 driven by the rotor shaft 42 in any convenient manner (not shown) and the head 74 has a pair of centrifugal weight arms 76 pivotally supported therefrom as at 78 with end portions engageable with a diametrically enlarged head 80 of an operating rod 82 secured to the lower end of the piston 52.

In operation, and with the cylinder body 22 positioned as illustrated in Figure 1 of the drawings and the piston 52 disposed in an upper position, the bore 36 is centrally disposed relative to the rotor shaft 42 and communication between the inlet pipe 38 and the pressure chamber 66 through the line 48, the valve cylinder 50 and the conduit 62 is terminated. Accordingly, fluid pressure acting upon the vanes 46 will act equally in opposite directions thereon resulting in the rotor shaft 42 remaining stationary. However, when fluid pressure in the line 48 increases sufficiently to urge the rod 82 downwardly to swing the weight arms 76 towards the positions thereof illustrated in Figure 1, the inlet end of the conduit 62 is uncovered by the head 56 and fluid pressure is admitted into the pressure chamber 66 which causes the cylinder body 22 to shift to the left as viewed in Figure 1 of the drawings against the biasing action of springs 30. This of course will result in the bore 36 being eccentrically positioned relative to the rotor shaft 42 in the manner illustrated in Figure 2 of the drawings whereupon fluid pressure passing through the slot 34 will cause the rotor body 44 to rotate in a counterclockwise direction as viewed in Figure 2 of the drawings.

If there is any tendency for the rotor shaft 42 to overspeed, the proportional overspeed of the head 74 of the governor 72 will cause the weight arms 76 to swing outwardly whereupon the base ends 86 of the arms will push upwardly on the rod 82 so as to shift the piston 52 upwardly toward the position thereof illustrated in Figure 1 of the drawings wherein the head 56 terminates communication between the line 48 and the conduit 62 thus preventing further increase of pressure in the chamber 66. If the limit of increase of pressure in the chamber 66 is not sufficient to check the overspeed of the rotor body 44, the governor 72 will spin faster resulting in the rod 82 being pushed further upwardly so as to vent the excess pressure from the chamber 66 through the conduit 62 and the line 68 whereupon the load on the rotor shaft 42 will decrease its speed of rotation and the weight arms 76 will bias the rod 82 upwardly with less force resulting in the pressure above the head 56 and the valve cylinder 50 being operable to urge the piston 52 downwardly to again communicate the conduit 62 with the line 48 so as to again increase the pressure within the chamber 66. Of course, if the load on the shaft 42 is increased the speed of rotation of the shaft 42 will be lowered and the pressure within the chamber 66 will be increased so as to further displace the cylinder body 22 toward the position thereof illustrated in Figure 2 of the drawings wherein maximum torque for a given source of fluid under pressure is developed by the motor 10. On the other hand, if the load on the rotor shaft 42 is reduced, the resultant increase in speed of the rotor shaft 42 will result in the rod 82 and the piston 52 being urged upwardly to throttle the pressure supplied to the chamber 66 through the valve cylinder 50 and thus allow the biasing action of the springs 30 to shift the cylinder body 22 back toward the position thereof illustrated in Figure 1 of the drawings until that position of eccentric displacement of the bore 36 relative to the rotor shaft 42 is reached wherein the torque developed by the motor 10 is substantially equivalent to the load on the rotor shaft 42.

With attention now invited more specifically to Figures 3 to 6 of the drawings, there may be seen a modified form of fluid motor referred to in general by the reference numeral 10^1 and including components thereof which are similar to some of the above mentioned components of the fluid motor 10

and which are therefore designated by corresponding prime reference numerals.

The motor 10^1 includes a different fluid pressure control system than that which is provided with the motor 10 in that the cylinder body 22^1 is provided with a first bore 100 that communicates the upper end of the slot 34^1 with the chamber 66^1 interiorly of the housing 12^1. In addition, the cylinder body 22^1 further includes a bore 102 having a restrictive zone 104 communicating the upper end of the slot 34^1 with a chamber 106 defined between the surface 32^1 and the inner surface of the side wall 18^1. Still further, one end wall 108 of the motor 10^1 includes a pressure relief passage 110 extending from the chamber 106 radially inwardly to the rotor shaft 42^1 and the latter includes a drilled passage 112 having a radially opening inlet end communicating with the passage 110 and a radially outwardly opening outlet end communicated with the inner end of a generally radial passage 114 formed in a governor body 116 mounted on the shaft 42^1. The governor body 116 includes an eccentrically shiftable weight 118 mounted thereon and the weight 118 is eccentrically weighted on the left side thereof illustrated in Figure 5 of the drawings while the right side thereof includes a needle valve element 120 for closing the radial outermost end of the passage 114 in response to the governor weight 118 shifting to the left as viewed in Figure 5 of the drawings.

In operation, when fluid pressure is supplied to the inlet pipe 38^1 the pressure of fluid within the chamber 66^1 increases and the cylinder body 22^1 is shifted to the left so as to eccentrically position the bore 36^1 relative to the rotor shaft 42^1. This of course causes counterclockwise rotation of the rotor body 44^1. However, a certain portion of the fluid under pressure entering the housing 12^1 through the inlet pipe 38^1 passes through the bore 102 and the restrictive zone 104 thereof and into the chamber 106 to assist the compression springs 30^1 in overcoming the biasing action of the fluid pressure within the chamber 66^1. However, until the desired operating speed of the rotor body 44^1 is reached, fluid pressure entering the chamber 106 is vented therefrom through the passages 110 and 112 and also the passage 114. When, however, the rotary speed of the shaft 42^1 reaches the desired limit, the governor weight 118 slides to the left as viewed in Figure 5 of the drawings so as to seat the needle valve element 120 in the radial outermost end of the bore or passage 114 whereby the bleeding of fluid pressure from the chamber 106 is terminated. Thus, fluid pressure within the chamber 106 is increased and the cylinder body 22^1 is pushed back toward the position thereof illustrated in Figure 3 of the drawings with the bore 36^1 eccentrically disposed relative to the shaft 42^1. Of course, as soon as the shifting of the cylinder body 22^1 to the right as viewed in Figure 3 as a result of an increase of pressure within the chamber 106 is sufficient to reduce the output torque of the motor 10^1 and thus the rotary speed of the shaft 42^1, the pressure within the passage 114 will be sufficient to cause the governor weight 118 to shift back towards the right as viewed in Figure 5 of the drawings so as to uncover the outlet end of the passage 114 and thus relieve some of the pressure within the chamber 106 allowing the cylinder body 22^1 to again shift toward the left as viewed in Figure 3 of the drawings until the eccentric positioning of the bore 36^1 relative to the shaft 42^1 is such that the torque output of the motor 10^1 is equal to the load on the shaft 42^1.

Thus it may be seen that the motors 10 and 10^1 operate in substantially the same manner and are each capable of automatically controlling the power output thereof to maintain a substantially constant rotor speed from a given source of fluid under pressure even though the load on the outlet shafts thereof may vary.

There has thus been described a sliding vane rotary fluid motor including a rotor cylinder shiftable laterally of the axis of rotation of the rotor between a first position generally concentric with the rotor axis and a second position eccentrically disposed relative to the rotor axis. Structure is provided for yieldingly biasing the cylinder toward its limit position concentric with the axis of rotation of the rotor and the cylinder defines a sliding partition within the housing of the motor with the partition closing one side of a fluid chamber within the motor housing. Rotor speed responsive fluid delivery structure is provided for ducting fluid under pressure from the intake of the motor into the chamber in response to a reduction in rotor speed to thereby overcome the biasing action acting upon the cylinder and shift the latter from its position concentric with the rotor axis toward its limit position of movement eccentrically disposed relative to the rotor axis.

The described fluid motors have been specifically designed for gang use and operation from a single source of fluid under pressure and without individual throttling of fluid pressure to the motors, even when they are to operate at different speeds and under different load conditions. The fluid motor is provided with a control system which, after being premetered, will be operative to develop from a constant source of fluid pressure varying power output at reasonably constant motor speeds.

Although the fluid motor has been specific-

ally designed for gang use it may also be utilized singly whenever desired with the same efficiency it possesses when operating in conjunction with other fluid motors from a single source of fluid under pressure.

The fluid motor may be utilized in a gang motor installation wherein all of the motors are supplied fluid under pressure from a single source and the motors may be required to develop varying power output at different motor speeds.

WHAT I CLAIM IS:—

1. A positive-displacement fluid motor having an inlet and an outlet and relatively positionable and movable components coacting to define a working chamber and in which the volume of fluid displaced for each output cycle is varied in response to changes in relative position of said components, the motor comprising means for varying the relative positions of the components for varying the volume of the displacement for each output cycle in response to load characteristics during operation of the motor, said means for varying the position of the components including means for spring biasing said relatively positionable components into a relative position to attain minimum volume displacement for each output cycle, fluid pressure means responsive to an increase in supply pressure at the inlet to shift said components against said biasing means in a direction to increase volume displacement of the motor for each output cycle as the supply pressure increases, and governor means operatively associated with said fluid pressure responsive means to decrease the effect of an increase in the supply pressure at the inlet as the speed of the output cycle increases.

2. A motor as claimed in Claim 1, wherein said motor includes at least one rotary component with a rotary output driving said governor means.

3. A motor as claimed in Claim 1, comprising a hollow housing, a sliding vane equipped rotor journalled in the housing, a cylinder disposed in the housing for limited shifting therein along a path extending generally diametrically of the cylinder, the rotor being disposed in the cylinder, the inlet and outlet opening into and out of the cylinder on opposite sides of said path, said cylinder and housing coacting to define a pair of variable-volume chambers located on opposite sides of the cylinder spaced along said path, means for enabling fluid pressure supply means to communicate said inlet with each of said pair of chambers, communication between said inlet means and one of said chambers being restricted and said spring means being operable to yieldingly bias said cylinder towards said other chamber along said path, and rotor speed controlled means for venting the fluid pressure in said one chamber so that fluid pressure in said other chamber moves the cylinder against said spring means until a predetermined speed of rotation of said rotor is attained whereupon said venting is terminated and said pair of chambers are subjected to substantially equal fluid pressure to substantially equally urge said cylinder in opposite directions along said path to permit said spring means to bias the cylinder towards said other chamber.

4. A motor as claimed in claim 3, wherein said rotor speed controlled means includes valve means operative to open and close a venting outlet means in response to decreases and increases, respectively, in the speed of rotation of said rotor.

5. A positive-displacement fluid motor substantially as herein described with reference to Figs. 1 and 2, or Figs. 3 to 6, of the accompanying drawings.

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Fig. 1

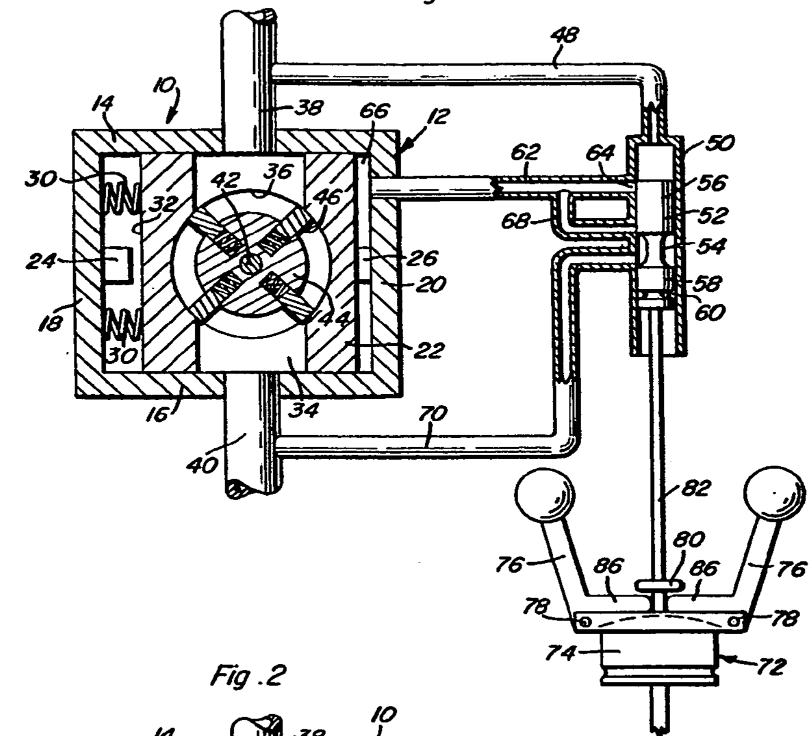
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Fig. 2

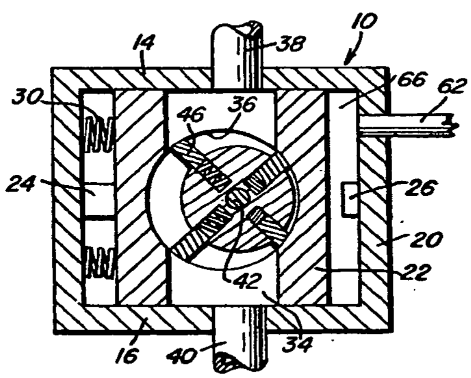
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Fig. 3

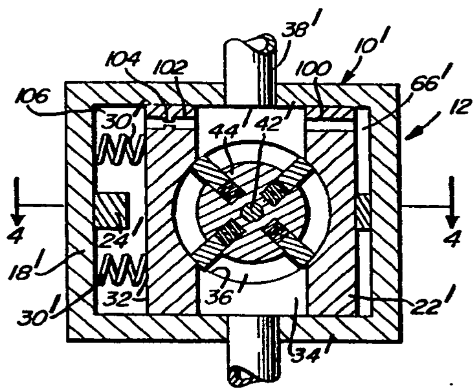


Fig. 4

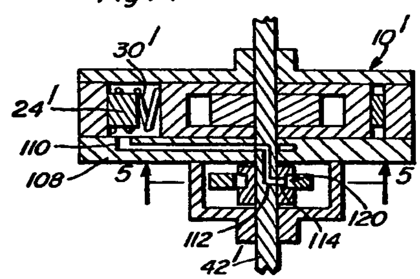


Fig. 5

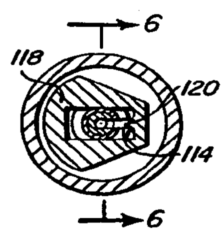
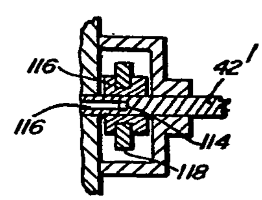


Fig. 6



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Application Data Sheet

Application Information

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Subject Matter::	Utility
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Title Line 2::	PRESSURE REGULATION OF
Title Line 3	OIL PUMPS
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Total Drawing Sheets	5
Small Entity	Yes
Petition Included::	No

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